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Lu et al.

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(54) **ELECTRONIC SYSTEM**

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(51) **Int. Cl.**

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G06F 3/02	(2006.01)
G06F 3/042	(2006.01)
G06F 3/0488	(2013.01)

(52) **U.S. Cl.**

CPC ***G06F 3/0416*** (2013.01); ***G06F 3/0227*** (2013.01); ***G06F 3/042*** (2013.01); ***G06F 3/04883*** (2013.01); ***G06F 3/04886*** (2013.01); *G06F 2203/04803* (2013.01); *G06F 2203/04808* (2013.01)

(58) **Field of Classification Search**

CPC G06F 3/0416; G06F 3/0227; G06F 3/042; G06F 3/0421; G06F 3/0428; G06F 3/04886; G06F 2203/04808; G06F 2203/04803; G06F 3/04883; G06F 3/03547

USPC 345/156–175; 178/18.01–18.09

See application file for complete search history.

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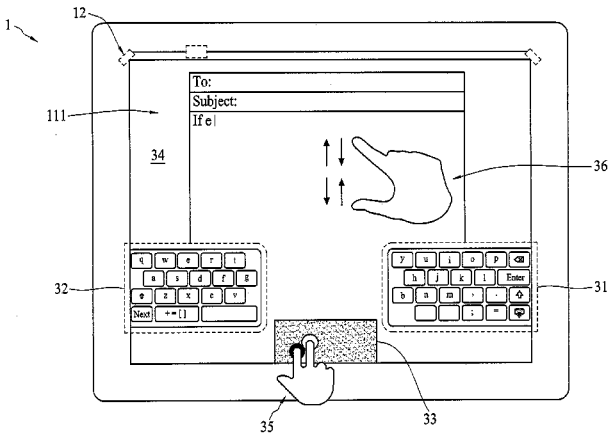
(57) **ABSTRACT**

An electronic system includes a device having a screen and an optical touch device. The optical touch device monitors the activity of an object on the screen of the device. When the object performs an operation in a first region of the screen, the optical touch device generates first data; and when the object performs an operation outside the first region, the optical touch device generates second data, wherein the first data and the second data are of different data types.

16 Claims, 15 Drawing Sheets



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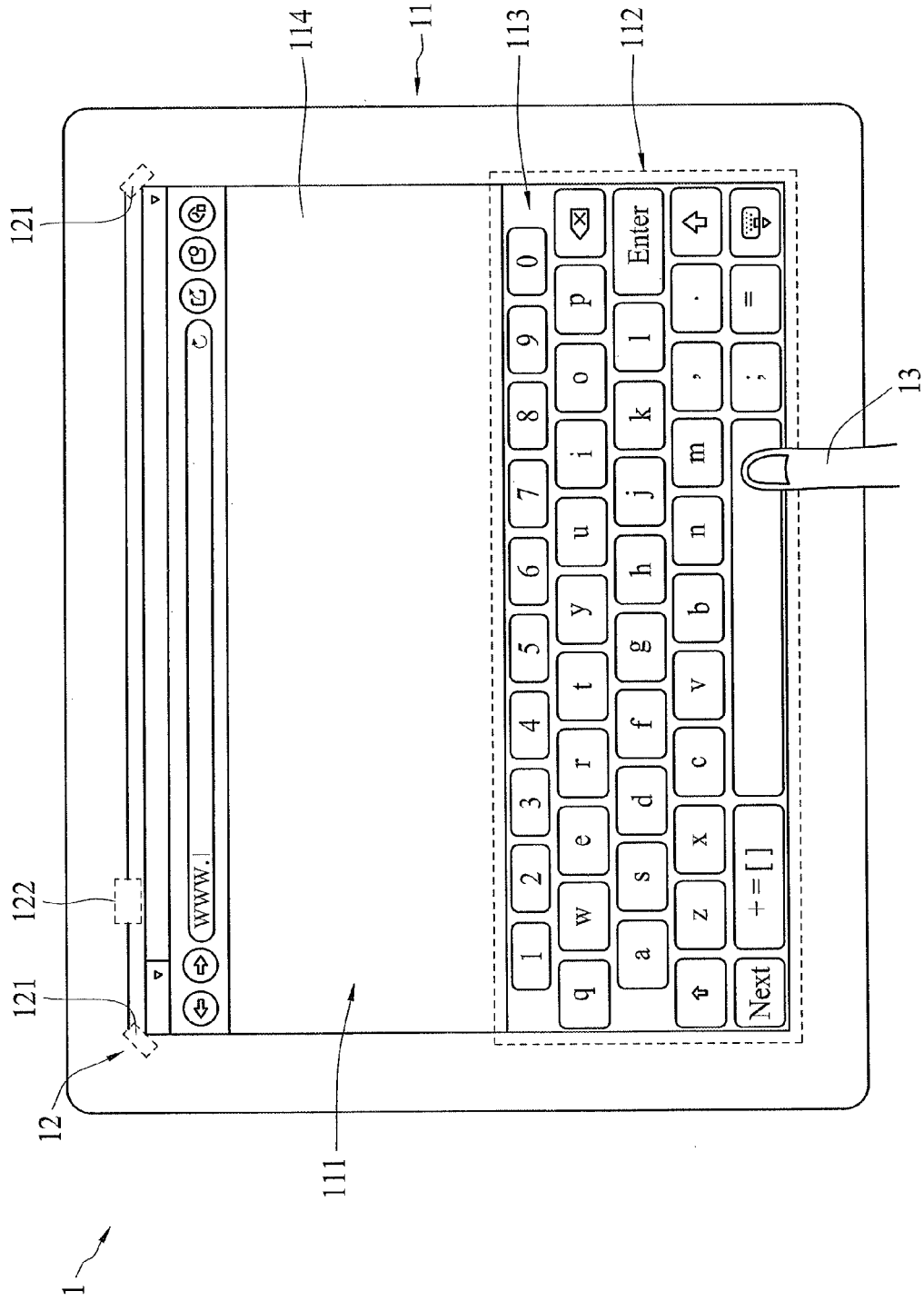

FIG. 1

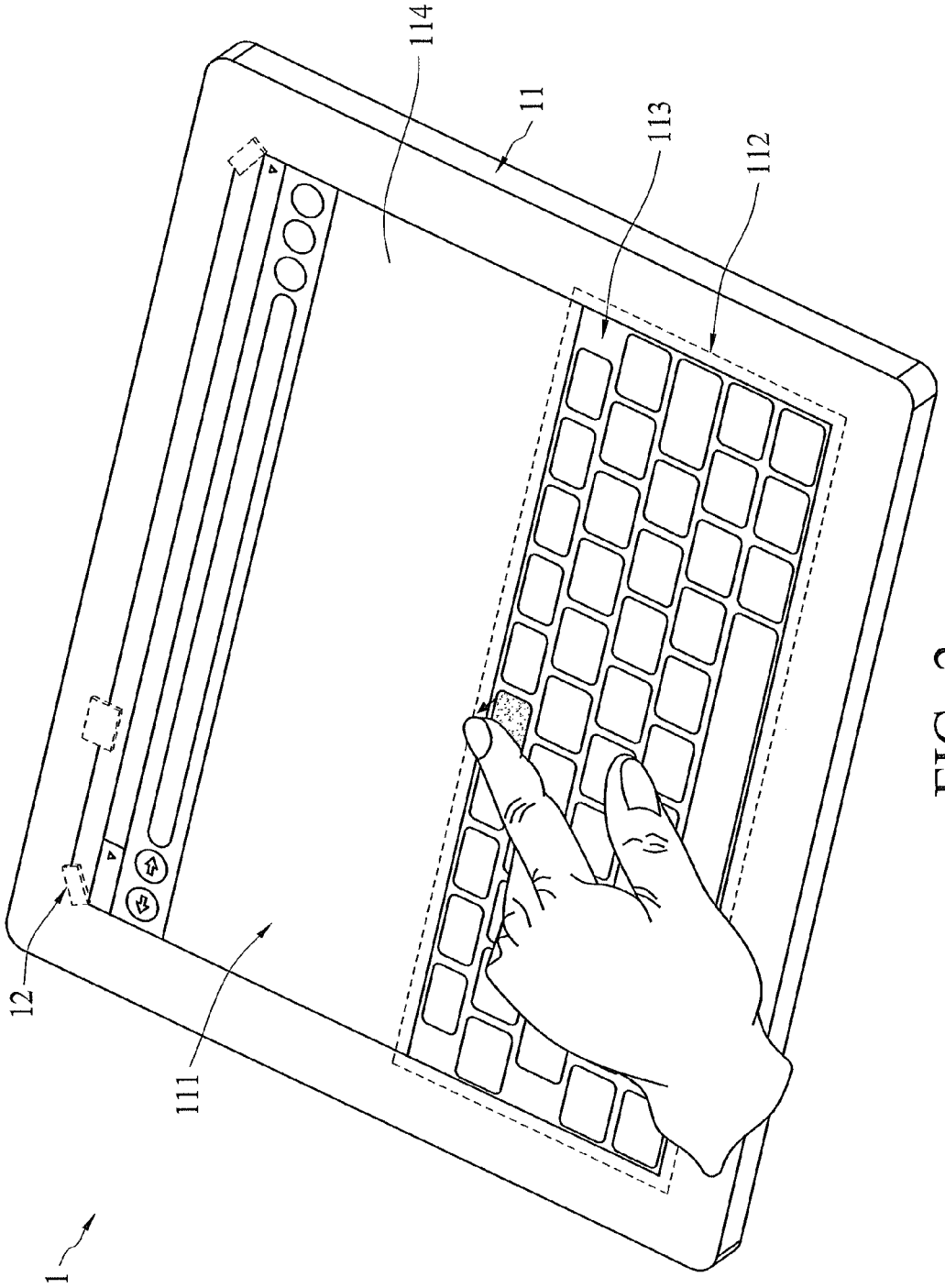

FIG. 2

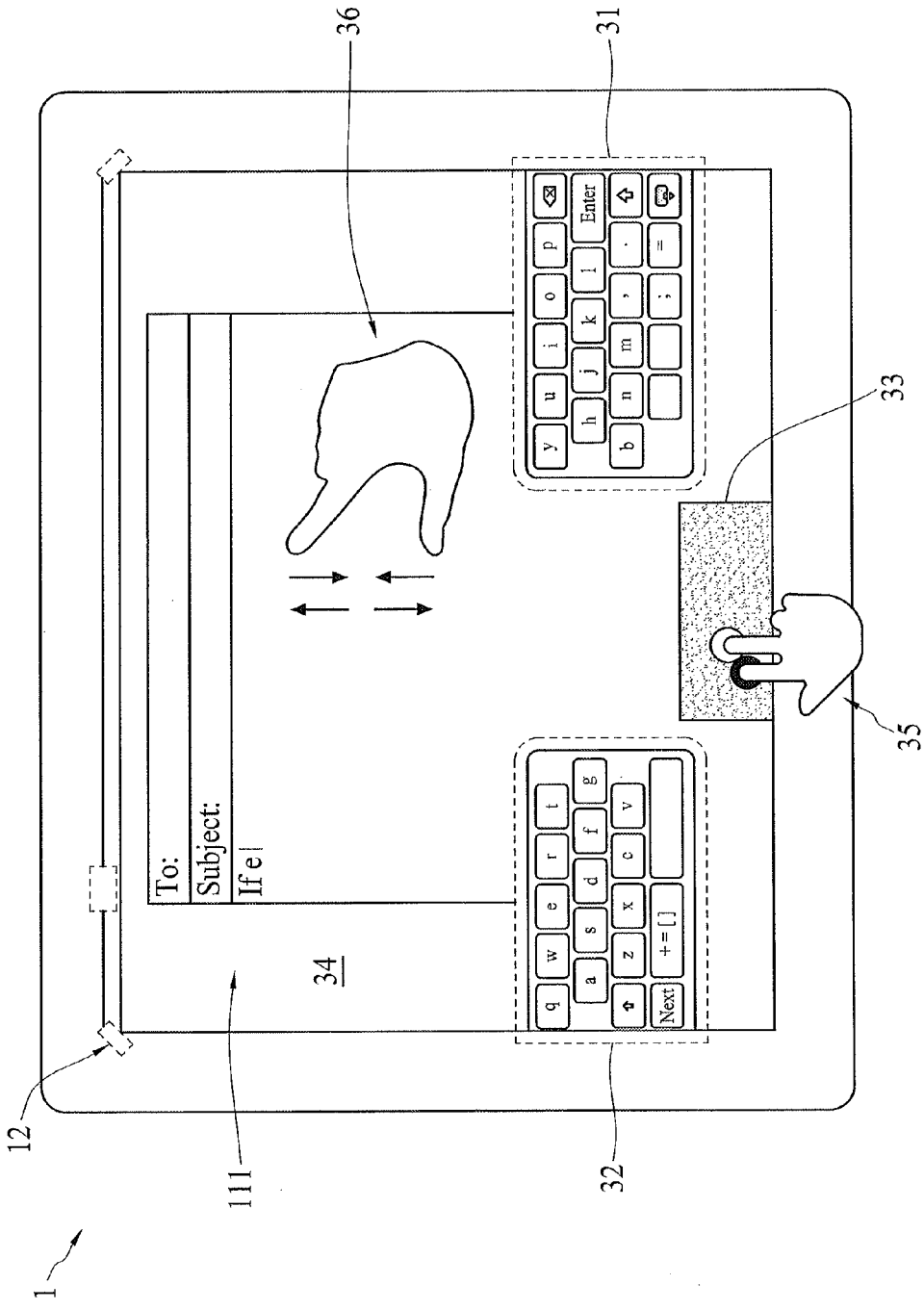

FIG. 3

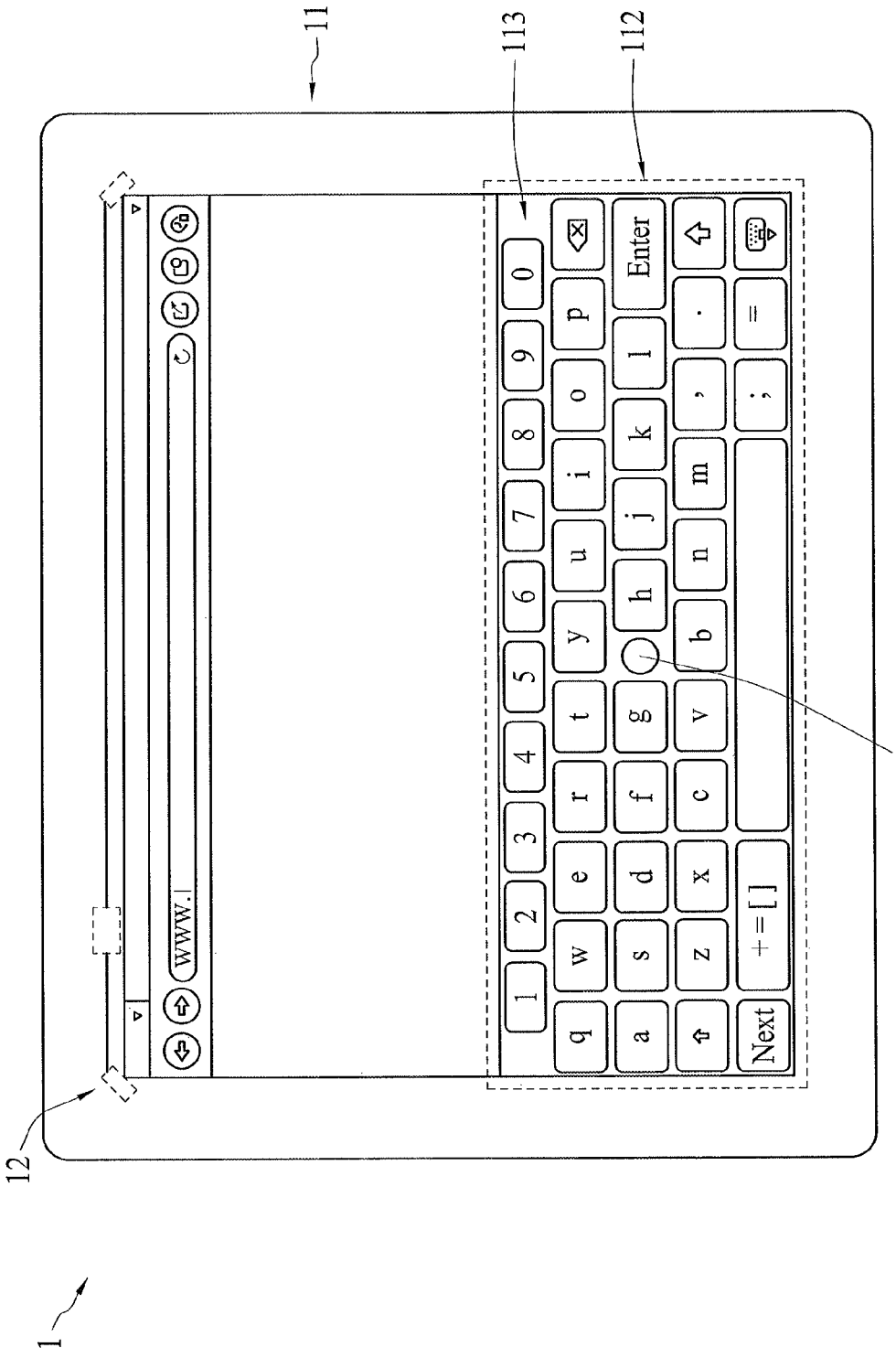

FIG. 4

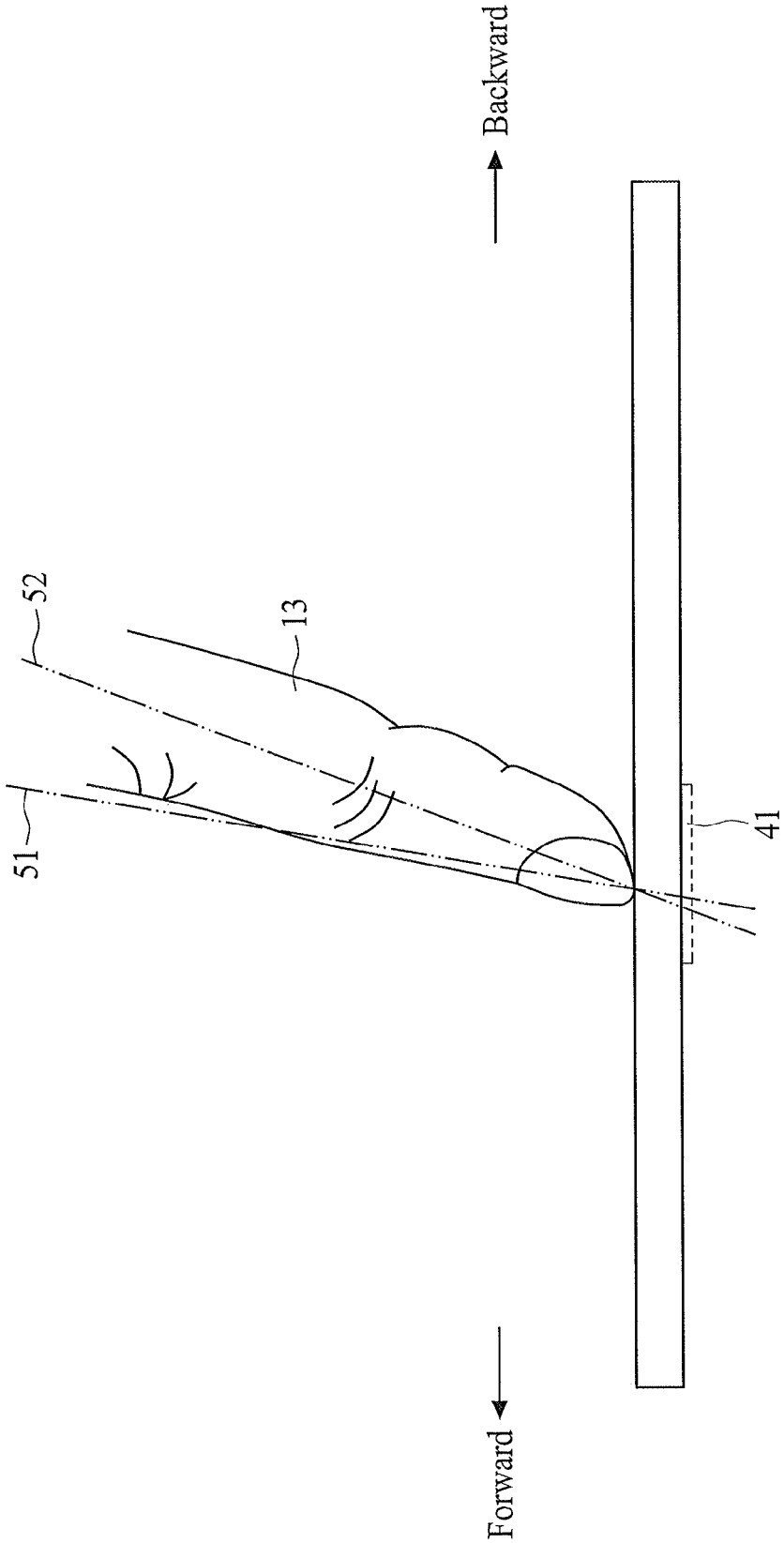

FIG. 5

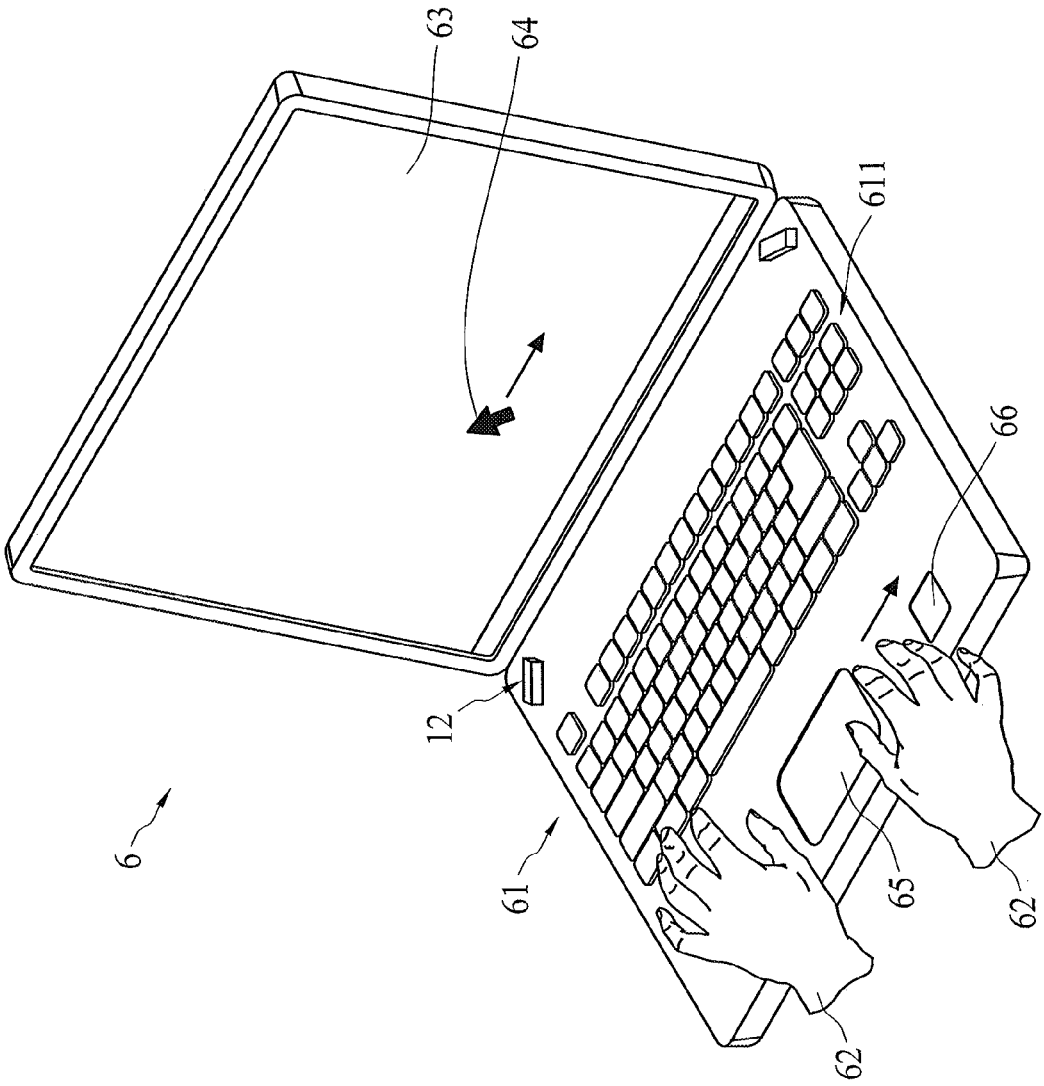

FIG. 6

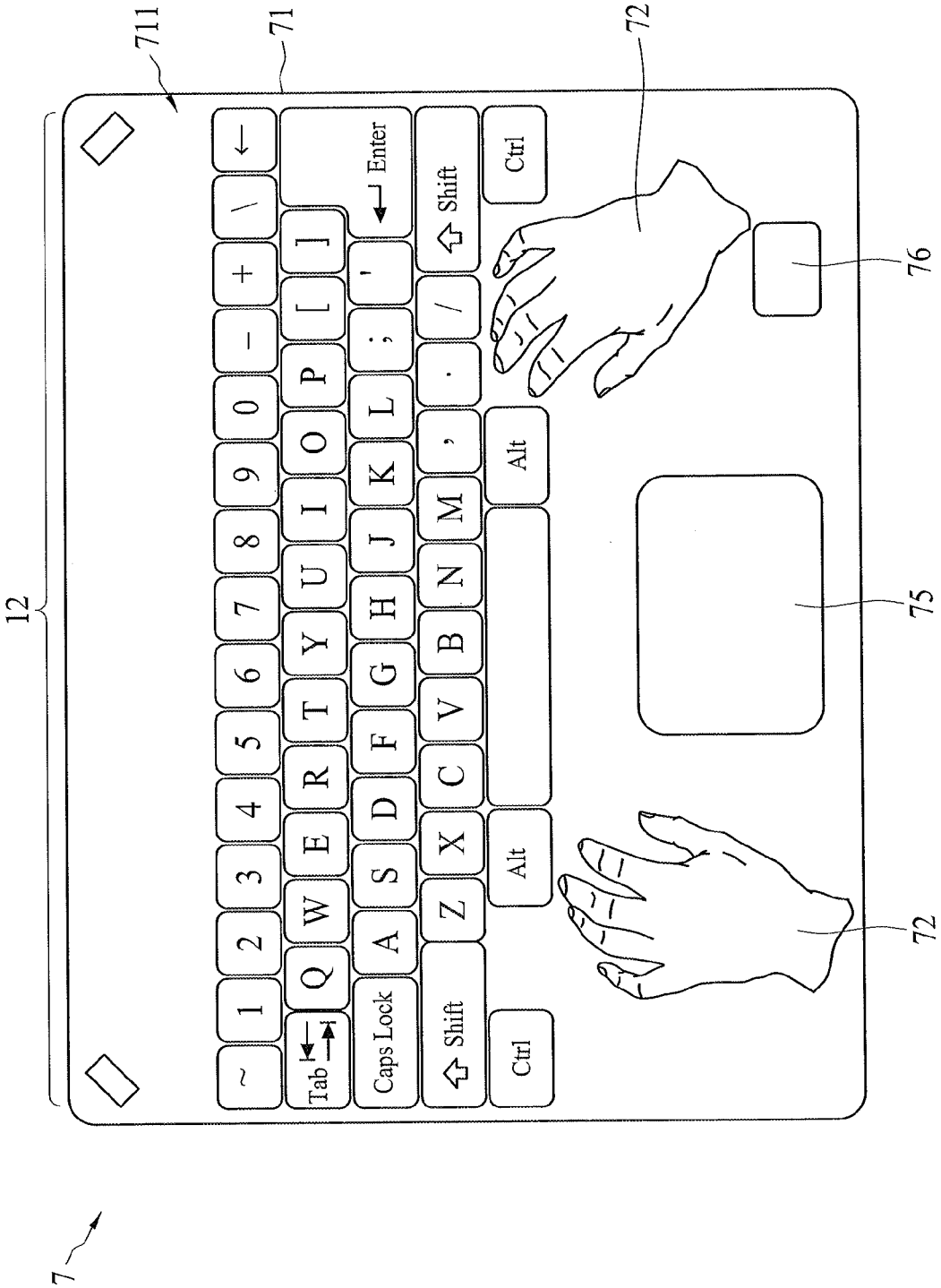

FIG. 7

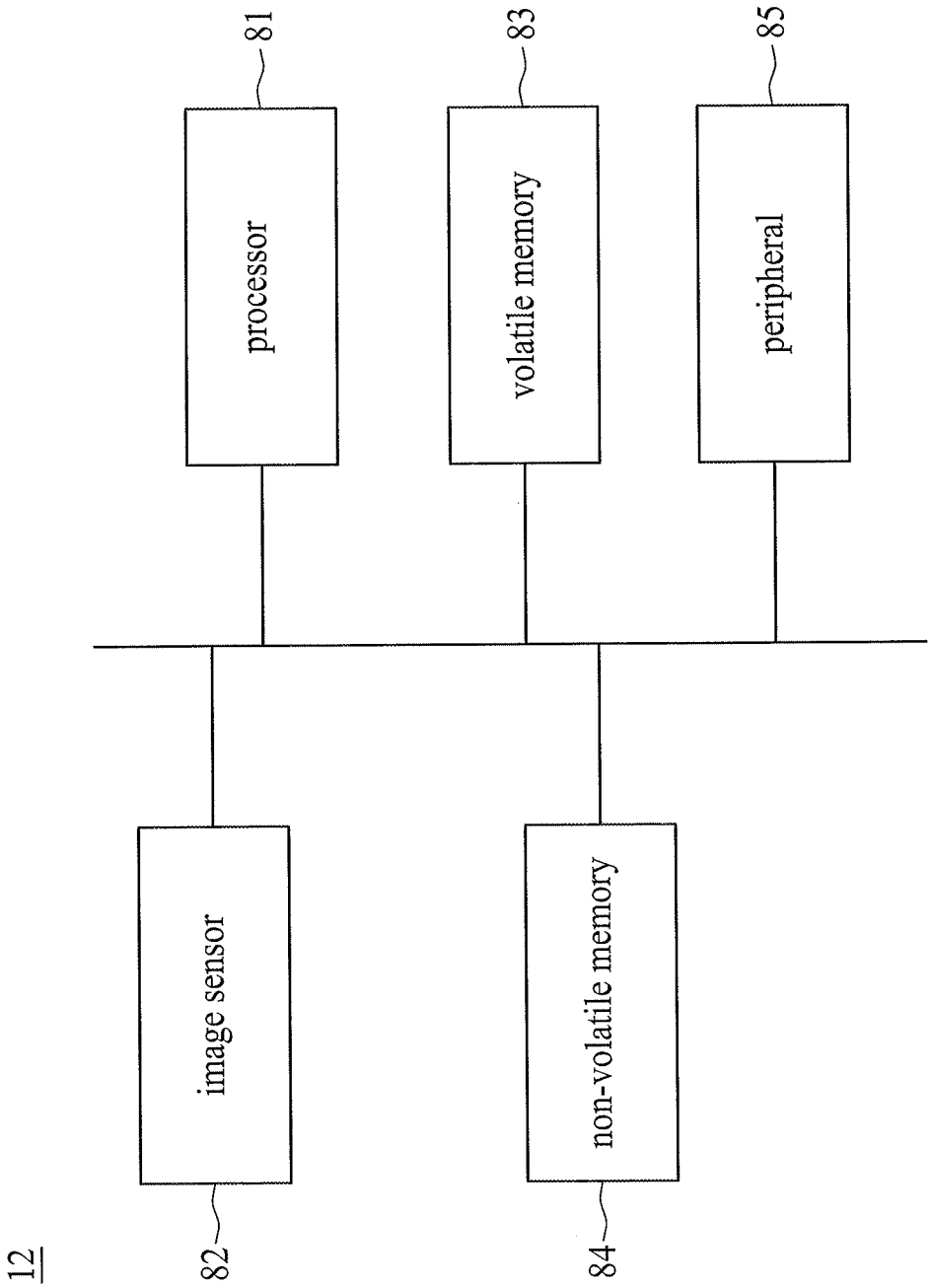
12
81
processor
83
volatile memory
85
peripheral
82
image sensor
84
non-volatile memory

FIG. 8

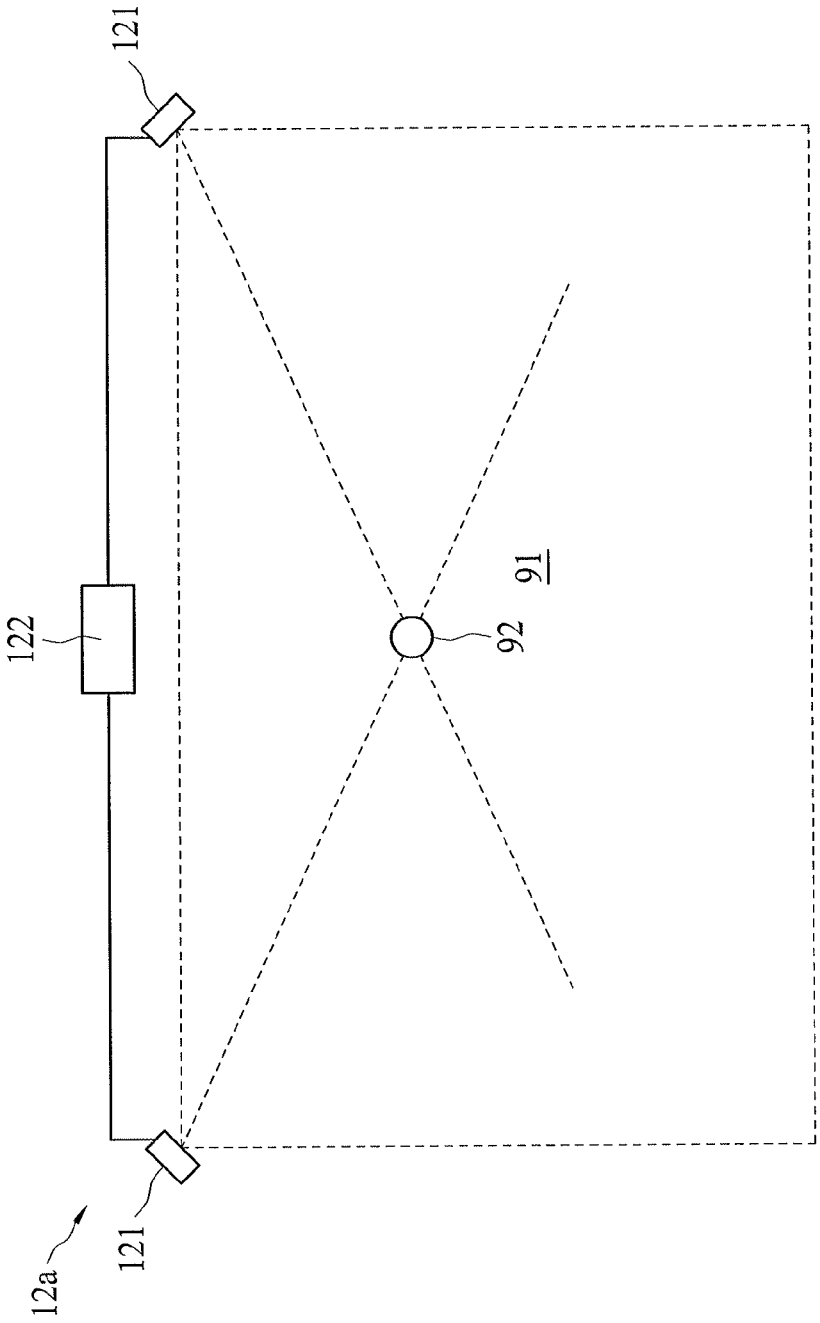

FIG. 9

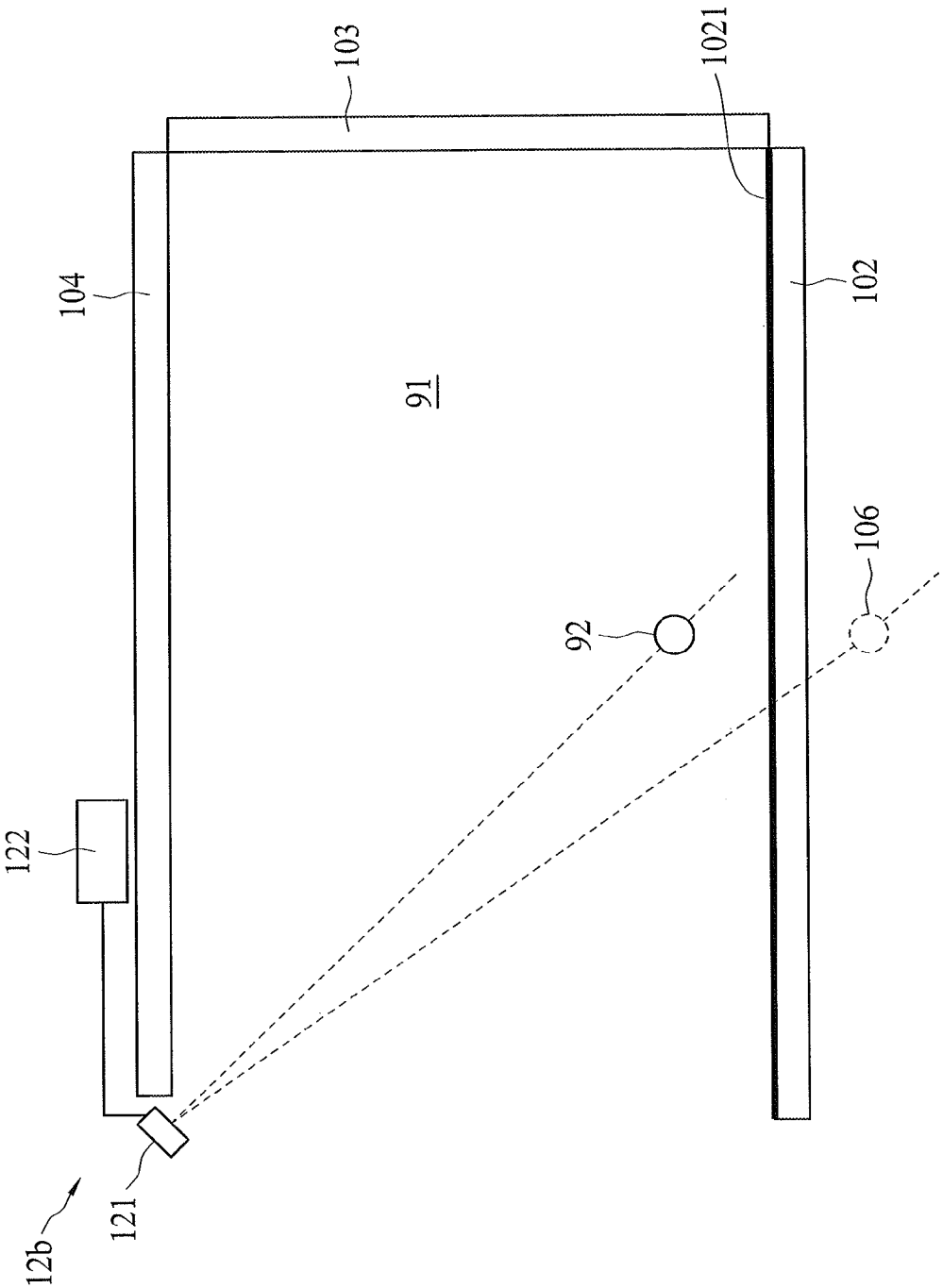

FIG. 10

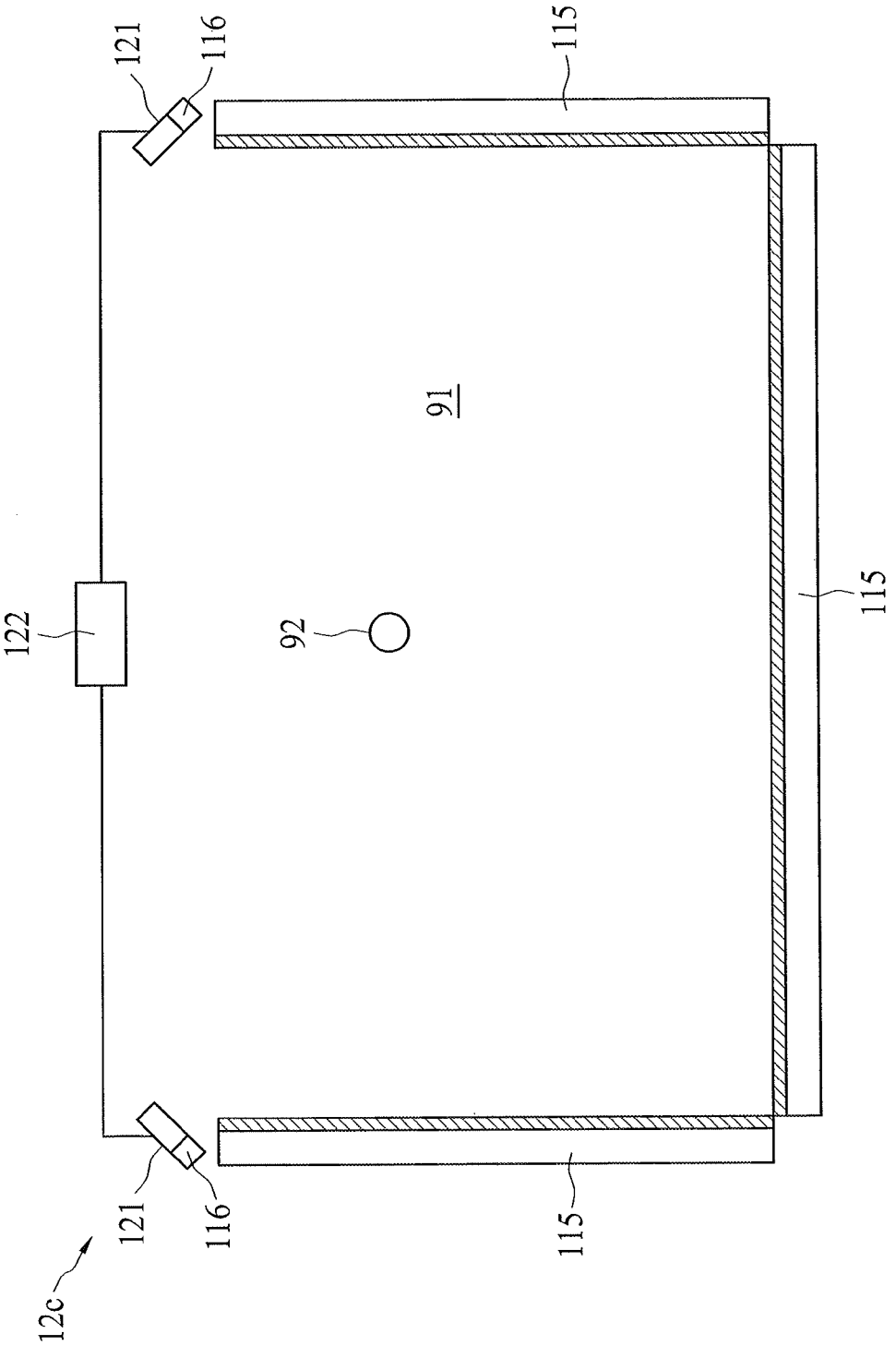

FIG. 11

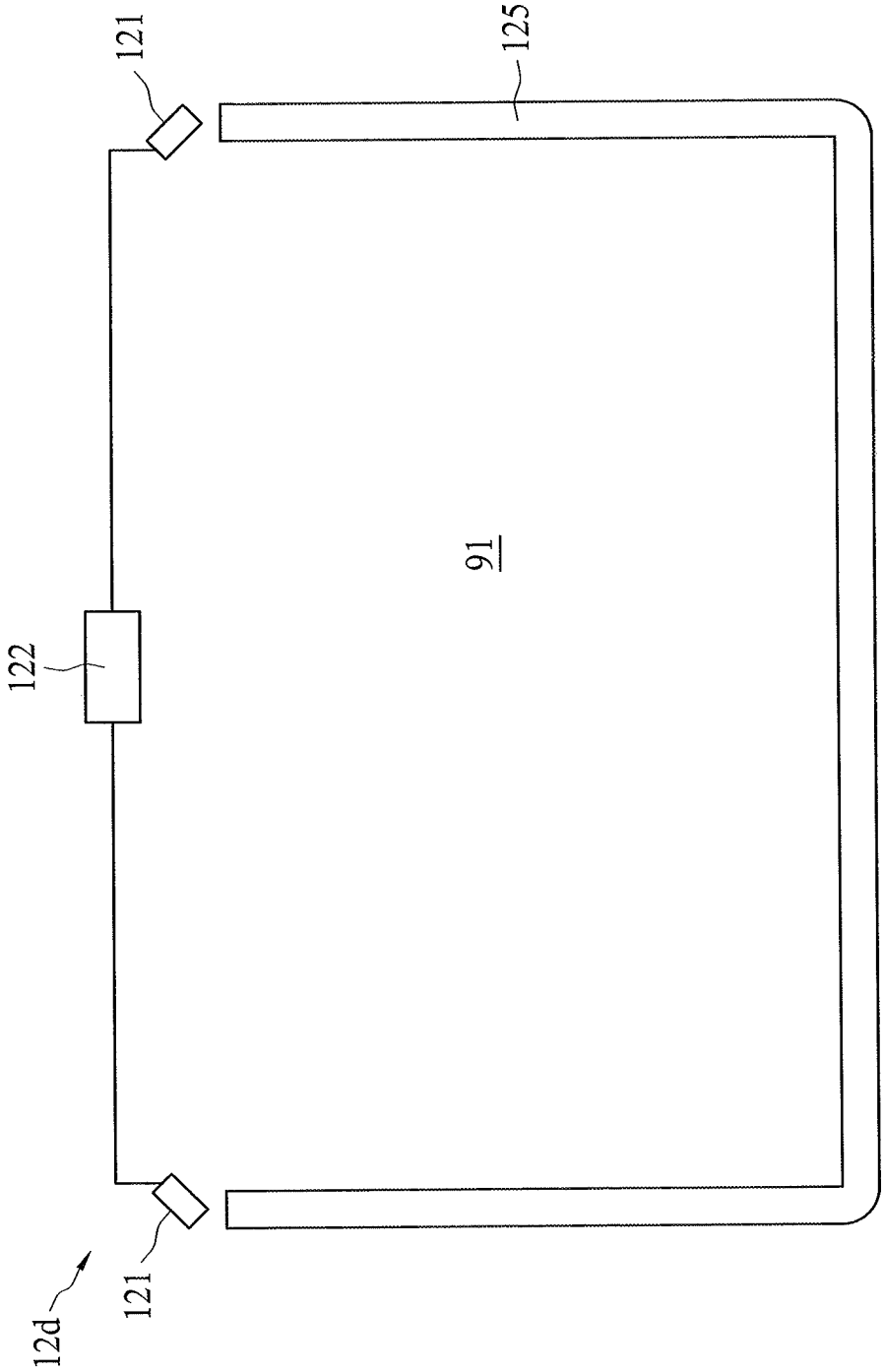

FIG. 12

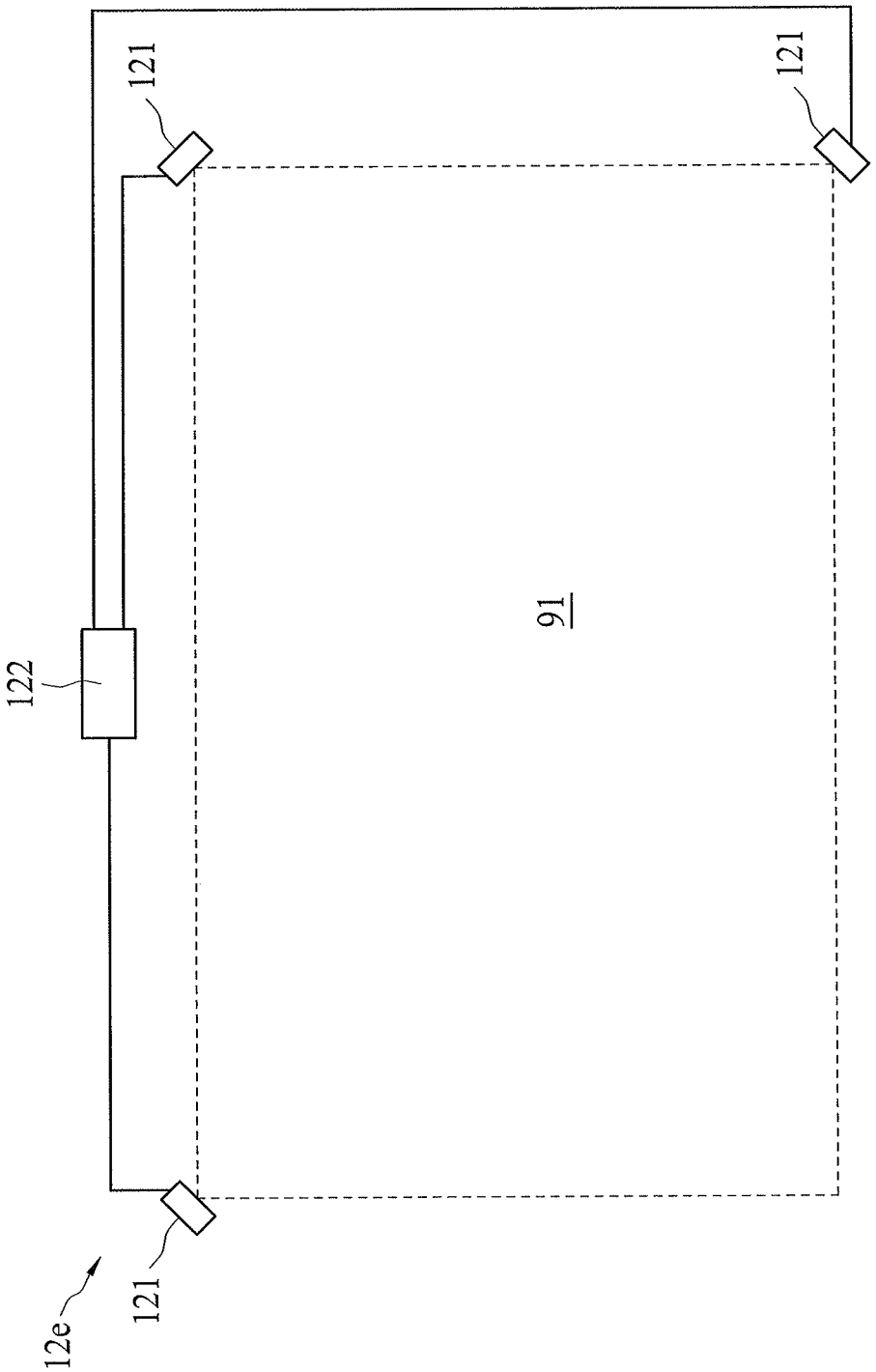

FIG. 13

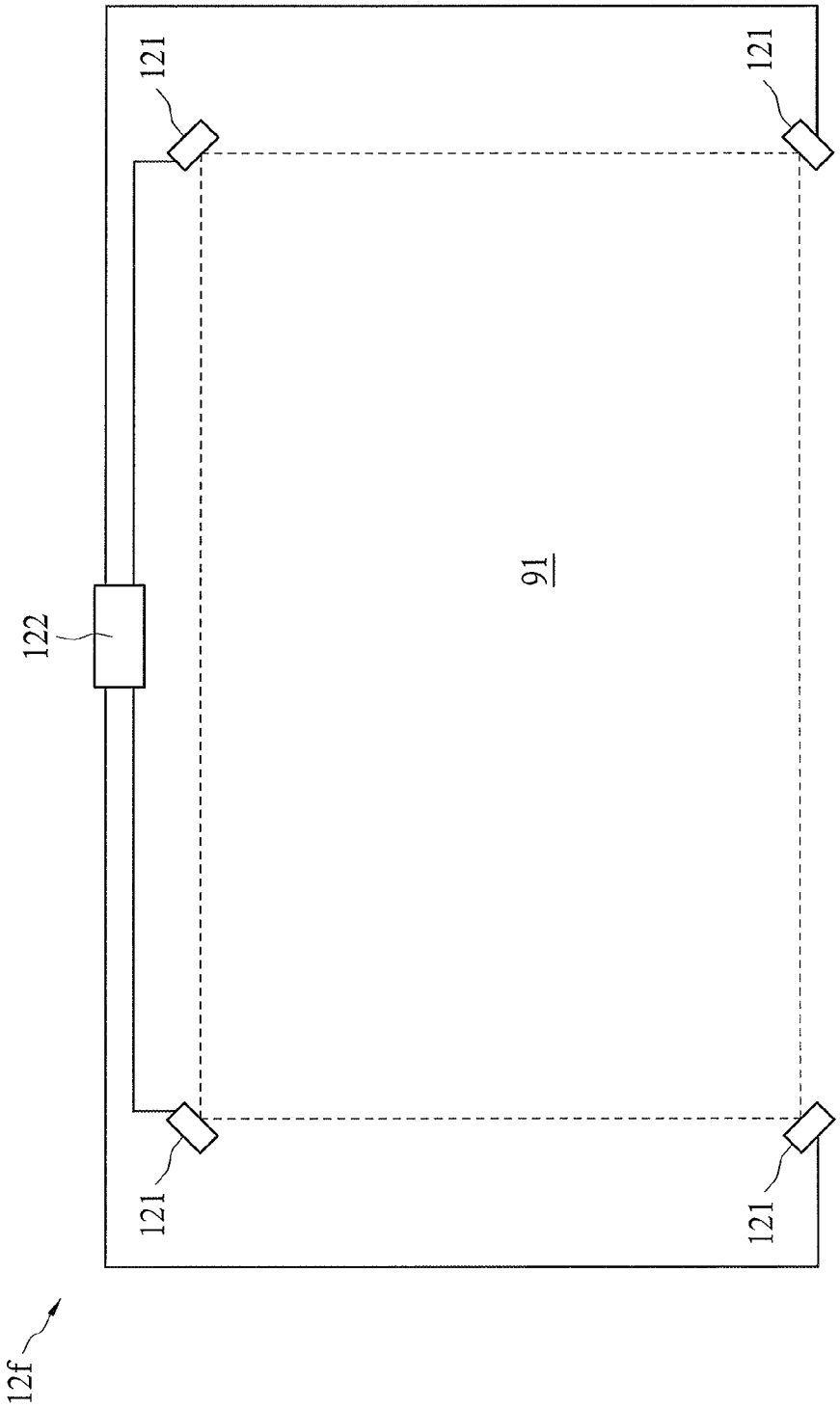

FIG. 14

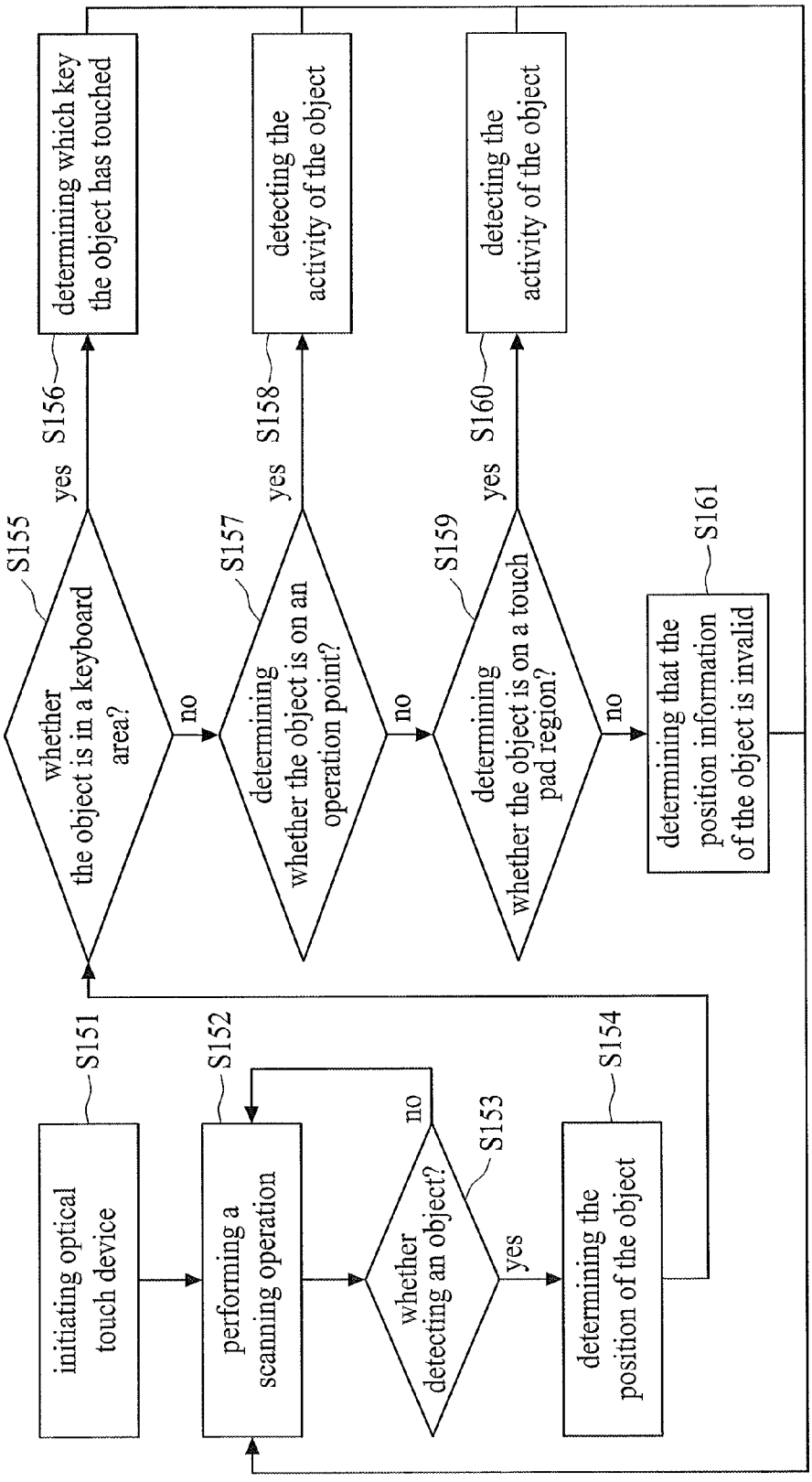
initiating optical touch device
S151
performing a scanning operation
S152
whether detecting an object?
S153
no
yes
determining the position of the object
S154
whether the object is in a keyboard area?
S155
yes
determining which key the object has touched
S156
no
determining whether the object is on an operation point?
S157
yes
detecting the activity of the object
S158
no
determining whether the object is on a touch pad region?
S159
yes
detecting the activity of the object
S160
no
determining that the position information of the object is invalid
S161

FIG. 15

ELECTRONIC SYSTEM

CROSS-REFERENCE TO RELATED APPLICATION

The present application is based on, and claims priority from, Taiwan Patent Application Serial Number 101113551, filed on Apr. 17, 2012, the disclosure of which is hereby incorporated by reference herein in its entirety.

BACKGROUND

1. Technical Field

The present invention relates to an electronic system, and particularly related to, an electronic computing system.

2. Related Art

Notebooks are a common type of small electronic computing system. A notebook usually has a screen and a keyboard. In addition to using the keyboard for inputting characters, users can attach a computer mouse to the notebook to control the motion of a cursor on the screen and to select a graphical item by clicking a button of the computer mouse. The computer mouse is normally placed beside the notebook, and when users input characters and manipulate a computer mouse, their hands have to move between the keyboard and the computer mouse.

Some notebooks have touch pads and track points. The touch pads and track points can replace computer mice so that when users operate the notebooks, users no longer need computer mice. However, notebooks with the touch pads and the track points installed include additional mechanisms and circuits.

Tablet computers are another type of small computer system. A tablet computer has a touch screen, by which users can operate the tablet computer. Generally, users use their fingers or a stylus to touch the screen to select a target. The touch control system computes the coordinates of the touch point, and sends the coordinates to the operating system of the tablet computer. The operating system will determine the desired target by the coordinates and execute the function representing the target.

SUMMARY

One embodiment of the present invention provides an electronic system, which comprises a device comprising a screen and an optical touch device. The optical touch device is configured to detect activity of an object on the screen. The optical touch device is also configured to generate first data when the object performs an operation on a first region of the screen and to generate second data when the object performs an operation outside the first region, wherein the first data and the second data is of different data types.

Another embodiment of the present invention discloses an electronic system, which comprises a device comprising a keyboard and an optical touch device. The optical touch device is configured to detect activity of an object on the keyboard, configured to generate a first gesture event.

Another embodiment of the present invention discloses an electronic system, which comprises a platform comprising a key assembly and an optical touch device. The optical touch device is configured to detect activity of an object on the key assembly to determine a key pressed by the object and to generate a corresponding key code.

To provide a better understanding of the above-described objectives, characteristics and advantages of the present invention, a detailed explanation is provided in the following embodiments with reference to the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described according to the appended drawings in which:

FIG. **1** schematically depicts an electronic system according to one embodiment of the present invention;

FIG. **2** schematically depicts an object performing an operation on an electronic system according to one embodiment of the present invention;

FIG. **3** schematically depicts an electronic system with a plurality of input regions according to one embodiment of the present invention;

FIG. **4** schematically depicts an electronic system having an operation point and a plurality of input regions according to one embodiment of the present invention;

FIG. **5** schematically depicts an object performing a gesture on an operation point;

FIG. **6** schematically depicts an electronic system according to another embodiment of the present invention;

FIG. **7** schematically depicts an electronic system according to another embodiment of the present invention;

FIG. **8** is a block diagram related to an optical touch device according to one embodiment of the present invention;

FIG. **9** schematically depicts an optical touch device according to one embodiment of the present invention;

FIG. **10** schematically depicts an optical touch device according to another embodiment of the present invention;

FIG. **11** schematically depicts an optical touch device according to another embodiment of the present invention;

FIG. **12** schematically depicts an optical touch device according to another embodiment of the present invention;

FIGS. **13** and **14** are views showing optical touch devices according to another embodiment of the present invention; and

FIG. **15** is a flow diagram showing the steps of a method for an optical touch device according to one embodiment of the present invention.

DETAILED DESCRIPTION OF DISCLOSED EMBODIMENTS

The following description is presented to enable any person skilled in the art to make and use the disclosed embodiments, and is provided in the context of a particular application and its requirements. Various modifications to the disclosed embodiments will be readily apparent to those skilled in the art, and the general principles defined herein may be applied to other embodiments and applications without departing from the spirit and scope of the disclosed embodiments. Thus, the disclosed embodiments are not limited to the embodiments shown, but are to be accorded the widest scope consistent with the principles and features disclosed herein.

Optical touch devices disclosed in some embodiments can output data other than touch point coordinates.

Optical touch devices disclosed in some embodiments can have the functions of multiple input devices.

Optical touch devices disclosed in some embodiments can provide the functions of multiple input devices.

Optical touch devices disclosed in some embodiments allow users to flexibly configure or set up desired input functions thereon.

FIG. **1** schematically depicts an electronic system **1** according to one embodiment of the present invention. Referring to FIG. **1**, the electronic system **1** comprises a device **11** and an optical touch device **12**. In some embodiments, the device **11** can be a portable electronic product such as, but not limited to, a mobile phone, a personal digital assistant, and a tablet computer. In some embodiments, the device **11** comprises a screen **111**, and the optical touch device **12** is configured to detect or monitor activity of an object **13** on the screen **111**. Specifically, the optical touch device **12** can detect the position of the object **13** on the screen **111** and send out the coordinate data of the position to device **11**. In the detectable area of the optical touch device **12**, at least one input region **112** can be arranged. The size, position, or other characteristics of the at least one input region **112** can be configured by users. The screen **111** displays a virtual input element **113** on the at least one input region **112**. The virtual input element **113** allows users to know the location of where they can perform input operations on the screen **111** or the virtual input element **113** provides guidance to users to perform input operations. The virtual input element **113** can be similar to a physical input device. When the object **13** performs operations in the input region **112**, the optical touch device **12** may generate data, wherein the data belongs to a type of data different from the type of data, to which the data, generated when the object **13** performs operations in a region **114** outside the input region **112**, belongs. In some embodiments, when the object **13** performs operations in the region **114** outside the region **112**, coordinate data of touch points are generated; when the object **13** touches the screen **111** in the input region **112**, no coordinate data is generated.

In some embodiments, coordinate data and non-coordinate data may belong to different types of data. In some embodiments, vector data and coordinate data can belong to different types of data. In some embodiments, gesture event information and coordinate data can belong to different types of data.

In some embodiments, the virtual input element **113** is a virtual keyboard as shown in FIG. **1**. A user can map out the position of a virtual keyboard in the detectable area of the optical touch device **12**. Afterward, the screen **111** will display the virtual keyboard, and the optical touch device **12** will performing a mapping between the virtual keyboard and the input region **112**. The user can input characters with the guidance of the virtual keyboard. Every time the object **13** touches a virtual key, the optical touch device **12** will determine the coordinate data of the touch point, determine a corresponding virtual key, and output a key code corresponding to the virtual key to the device **11**. The device **11** will then display a corresponding character on the screen **111**. In some embodiments, the key code may comprise a scan code. The key code can be transmitted to a physical interface of the device **11**, which can translate the key code into an ASCII equivalent. In some embodiments, the optical touch device **12** can translate the key code into the ASCII equivalent, send the ASCII equivalent to the device **11**, and display the corresponding character. The optical touch device **12** directly outputting ASCII equivalents can reduce the computational burden of the device for character input.

The optical touch device **12** allows users to map out the input region **112** by their own choices. Namely, users can configure an input region **112** of any size at any location in the detectable area of the optical touch device **12**. In some embodiments, users can move the object **13** to surround a region, which is then used as an input region **112**, in the detectable area of the optical touch device **12**. In some embodiments, users can provide two opposite corner points of an input region **112** to define the input region **112** in the detectable area of the optical touch device **12**. The present invention is not limited to the above-mentioned embodiments; other suitable methods for configuring an input region **112** are also applicable.

The optical touch device **12** allows users to configure multiple different regions for different types of input methods to meet the requirements of the users.

In some embodiments; the object **13** may comprise a stylus, a finger, or the like that is suitable for a touching operation.

In some embodiments, when the object **13** touches a virtual key, the optical touch device **12** sends out a key code. In some embodiments, when the object **13** touches a virtual key, the virtual key will change such that the users can know that the virtual key has been selected. In some embodiments, when the object **13** contacts the screen **111** for selecting a virtual key, the optical touch device **12** does not instantly send out a key code, and the key code corresponding to the selected virtual key is sent out by the optical touch device **12** after the object **13** moves away from the screen **111**, as shown in FIG. **2**.

In some embodiments, when a plurality of objects **13** are in contact with the virtual keyboard, the optical touch device **12** stops sending out key codes to avoid improper input that may lead to an incorrect result generated by the device **11**.

FIG. **3** schematically depicts an electronic system **1** with a plurality of input regions according to one embodiment of the present invention. Referring to FIG. **3**, users can freely define two sub-regions **31** and **32** in the detectable area of the optical touch device **12**, and the screen **111** displays portions of a virtual keyboard on the plurality of input regions **31** and **32**, respectively. With the guidance of the virtual keyboard, users can input characters using the two sub-regions **31** and **32** to insert characters into displayed documents. In addition, users can define another input region **33** adjacent to the virtual keyboard, wherein the input region **33** corresponds to an input method different from that corresponding to the two sub-regions **31** and **32**. In some embodiments, the input region **33** is configured for gesture input, and in some embodiments, applicable gestures can be determined by users. In some embodiments, a region **34** other than the sub-regions **31** and **32** and the input region **33** is configured for gestures different from those performed in the region **33**. In some embodiments, different regions, for example the input region **33** and the region **34**, are configured to generate different gesture events when the same gesture is performed on the different regions. In some embodiments, the optical touch device **12** is configured to determine whether a gesture is performed on the input region **33** or the region **34** using a starting position of the gesture or a plurality of positions of the gesture movement.

In some embodiments, when a gesture is performed on different regions, for example the input region **33** and the region **34**, the optical touch device is configured to execute a function related to one of the regions, on which the gesture lasts longer in distance or time.

In some embodiments, users can perform the press-and-tap gesture **35** on the input region **33** to open a shortcut menu, and the press-and-tap gesture **35** cannot be performed on the region **34**. In some embodiments, users can configure different gestures to be performed on different regions.

The optical touch device **12** can be configured such that the same gesture can be performed on a plurality of regions. Referring to FIG. **3**, in some embodiments, the zoom in/out gesture **36** can be performed on the region **33** and the region

34. In some embodiments, the optical touch device **12** is configured such that at least one gesture can be performed on all regions.

The optical touch device **12** can be configured such that performing a gesture on different regions can generate different effects. Referring to FIG. **3**, in some embodiments, the optical touch device **12** can be configured such that the scroll gesture is used to control the text cursor in an editing document within the region **33**, while the scroll gesture is used to scroll an editing document within the region **34**.

In some embodiments, the optical touch device **12** can be configured to operate functions that are allowed to do on a physical touch panel on the input region **33**. For example, when a user moves a finger on the input region **33**, the optical touch device **12** can output a relative displacement vector.

In some embodiments, users are allowed to define a region **33** of any size at any location in the detectable area of the optical touch device **12**. In some embodiments, users can define a region as the region **33** by moving the object **35** to delineate the boundary of the region in the detectable area of the optical touch device **12**. In some embodiments, users can provide the coordinate data of two opposite corner points of the region **33** to define the region **33** as a rectangular.

Referring to FIG. **3**, in some embodiments, users may not define another region **33**, but switch the sub-region **31** or the sub-region **32** into the region **33**. In other words, users are allowed to change the sub-region **31** or the sub-region **32** for inputting characters into the region **33** functioning as a touch panel.

Referring to FIGS. **4** and **5**, in addition to configuring the input region **112** for inputting characters, users may set up an operation point **41** in the detectable area of the optical touch device **12**. In some embodiments, the operation point **41** is disposed outside the region **112** corresponding to the virtual keyboard. In some embodiments, the operation point **41** can be disposed in the region **112** corresponding to the virtual keyboard as shown in FIG. **4**. As shown in FIG. **5**, in some embodiments, the object **13** touches the operation point **41**, defining an initial posture **51**, and then tilts backward to a posture **52**. During this moment, the optical touch device **12** detects that the object **13** is tilting backwards, and then generates a corresponding gesture event such as a backward scroll event or a backward movement event. Similarly, if the object **13** tilts right, the optical touch device **12** generates a right scroll event or a right movement event. In some embodiments, when the object **13** tilts from an initial posture to an inclined posture and remains on the operation point **41**, the optical touch device **12** repeatedly outputs a same corresponding gesture event to the device **11**.

Referring to FIG. **4**, in some embodiments, when the object **13** is on the operation point **41**, the optical touch device **12** will stop outputting the results generated from the operations performed in the input region **112** by the object **13**. In some embodiments, when the object **13** touches the operation point **41**, the optical touch device **12** may suspend the function (for example, a function of inputting characters) configured for the input region **112** and restores the original function (for example, a function of outputting coordinate data) that the optical touch device **12** provides. In some embodiments, when the object **13** is on the operation point **41**, the optical touch device **12** may suspend the function of the virtual keyboard. At this moment, if the object **13** moves on the virtual keyboard, the optical touch device **12** does not output key codes but outputs object coordinate data or scroll events.

As shown in FIG. **4**, in some embodiments, users can define an operation point **41** at any location in the detectable area of the optical touch device **12** and assign a shortcut function to the operation point **41**. In some embodiments, when the operation point **41** is touched, simultaneous touches on the screens are simulated, and a plurality of functions are simultaneously performed. In some embodiments, when the operation point **41** is touched, simultaneous touches on a plurality of virtual keys are simulated.

FIG. **6** schematically depicts an electronic system **6** according to another embodiment of the present invention. As shown in FIG. **6**, the electronic system **6** comprises a device **61** and an optical touch device **12**. The device **61** comprises a physical keyboard **611**. The optical touch device **12** is configured to detect activity of an object **62** on the keyboard **611** to correspondingly output a gesture event.

In some embodiments, the device **61** comprises an electronic device with a physical keyboard, for example, a notebook. In some embodiments, the device **61** is a physical keyboard, by which users can input characters. In some embodiments, the device **61** comprises a mobile device with a physical keyboard.

In some embodiments, the device **61** comprises a screen **63**. The screen **63** may display a pointing cursor **64**, and the object **62** can move above the keyboard **611** to move the pointing cursor **64** on the screen **63**. For example, when the object **62** moves left or right over the keyboard **611**, the pointing cursor **64** moves left or right accordingly; when the object **62** moves toward the screen **63** or toward users, the pointing cursor **64** may move upward or downward accordingly. In some embodiments, when the object **62** moves, the optical touch device **12** determines a displacement vector ($\vec{x},\vec{y}$) of the object **62** and outputs the vector ($\vec{x},\vec{y}$) to the device **61**. The device **61** then moves the pointing cursor **64** by the received vector ($\vec{x},\vec{y}$). In some embodiments, the vector ($\vec{x},\vec{y}$) can be transmitted using the standard protocol format such as PS2, ImPS/2 or IMPS/2. In some embodiments, the vector ($\vec{x},\vec{y}$) can be transmitted using a user-defined format. Since users can perform gestures over keyboards to simulate computer mouse events, they do not need computer mice to perform input operations.

Furthermore, referring to FIG. **6**, in some embodiments, the object **62** can move above the keyboard **611** to allow the optical touch device **12** to provide a scroll event to the device **61** for scrolling a window. In some embodiments, users can perform a pinch gesture above the keyboard **611** to shrink a window. In some embodiments, users can perform a spread gesture to magnify a window. The above-mentioned gestures are examples; other gestures not disclosed can also be performed above the keyboard **611**.

In some embodiments, the keyboard **611** can be configured to have different regions, and the optical touch device **12** is configured to generate different gesture events when the same gesture is performed on the different regions. Furthermore, the optical touch device **12** can be configured to determine whether a gesture is performed on one region or another region of the keyboard **611** using a starting position of the gesture or a plurality of positions of the gesture movement.

Referring back to FIG. **6**, the electronic system **6** comprises a touch pad **65**, and the optical touch device **12** can detect the a gesture that the object **62** performs on the touch pad **65**, generate a gesture event, and send the gesture event to the device **61**. For example, users may use fingers perform a press-and-tap gesture on the touch pad **65**, and after the

optical touch device **12** detects that the fingers have performed a press-and-tap gesture, the optical touch device **12** sends a press-and-tap event to the device **61**. In some embodiments, at least one gesture is allowed to be performed on the touch pad **65**, but not allowed to be performed above the keyboard **611**. For example, the optical touch device **12** is configured such that performing the press-and-tap gesture on the touch pad **65** can generate a gesture event, but performing the press-and-tap above the keyboard **611** cannot generate a gesture event. In some embodiments, at least one gesture can be performed on the touch pad **65** and above the keyboard **611**. For example, the optical touch device **12** may be configured such that the pinch gesture and the spread gesture can be performed on the touch pad **65** and the keyboard **611**.

Referring to FIG. **6** again, the electronic system **6** may further comprise an operation point **66**, on which the object **62** can be placed for a gesture input operation. In some embodiments, as similarly shown in FIG. **5**, when the object **62** is touching the operation point **66**, the object **62** can tilt to allow the optical touch device **12** to generate a scroll event. In some embodiments, when the object **62** moves from one posture to another posture and continues touching the operation point **66**, the optical touch device **12** repeatedly outputs a corresponding gesture event to the device **61**. In some embodiments, the function of the optical touch device **12** performed on the operation point **66** is similar to that of the track point or a pointing stick of a general notebook.

FIG. **7** schematically depicts an electronic system **7** according to another embodiment of the present invention. As shown in FIG. **7**, the electronic system **7** comprises a platform **71** and an optical touch device **12**. The platform **71** may comprise a key assembly **711**. The optical touch device **12** can detect activity of an object **72** above the key assembly **711** to determine the key that the object **72** has pressed and then output the key code corresponding to the pressed key.

In some embodiments, the optical touch device **12** can store coordinate data corresponding to each key in advance. After determining coordinate data of the object **72**, the optical touch device **12** can find out the corresponding key and send out the corresponding key code.

In some embodiments, the optical touch device **12** may analyze the up-and-down position change of a key between an image and a later-captured image, the change of the shape of a finger, or the up-and-down position change of the tip of a finger to determine the finger that has pressed a key, and then determine the corresponding key and output the corresponding key code.

In some embodiments, the optical touch device **12** may connect to an electronic device, which is connected with a screen showing a pointing cursor. The pointing cursor can be moved by moving the object **72** with the help of the optical touch device **12**.

In some embodiments, the object **72** may perform gestures over the key assembly **711** to perform gesture operations. For example, the object **72** can move on the key assembly **711** to allow the optical touch device **12** to generate a scroll event.

In some embodiments, the key assembly **711** can be configured to have different regions, and the optical touch device **12** is configured to generate different gesture events when the same gesture is performed on the different regions. Furthermore, the optical touch device **12** can be configured to determine whether a gesture is performed on one region or another region of the key assembly **711** using a starting position of the gesture or a plurality of positions of the gesture movement.

In some embodiments, the platform **71** may not comprise a control circuitry for the key assembly **711**; namely, without the control circuitry, no signal is generated when a key of the key assembly **711** is pressed. In some embodiments, the platform **71** may comprise a control circuitry to generate signals corresponding to the press of the key assembly **711**.

As shown in FIG. **7**, the platform **71** may comprise a touch pad region **75**, and the optical touch device **12** is configured to detect activity of the object **72** on the touch pad region **75** for detecting the gestures performed by the object **72**. For example, the finger of a user may perform a press-and-tap gesture on the touch pad region **75**, and after the optical touch device **12** detects that the press-and-tap gesture is formed, the optical touch device **12** generates a press-and-tap event. In some embodiments, the optical touch device **12** is configured such that different gestures are performed on the key assembly **711** and the touch pad region **75**. For example, the optical touch device **12** may be configured such that a press-and-tap gesture is applicable on the touch pad region **75**, while the press-and-tap gesture cannot be performed on the key assembly **711**. Furthermore, the optical touch device **12** may be configured such that a page flip gesture is applicable on the key assembly **711**, while the page flip gesture cannot be performed on the touch pad region **75**.

The platform **71** may comprise an operation point **76**. The object **72** can touch the operation point **76** to perform a gesture input operation. In some embodiments, as similarly shown in FIG. **5**, when the object **72** is touching the operation point **76**, the object **72** can tilt to allow the optical touch device **12** to generate a scroll event. In some embodiments, when the object **72** moves from one posture to another posture and continues touching the operation point **76**, the optical touch device **12** repeatedly outputs a corresponding gesture event.

FIG. **8** is a block diagram related to an optical touch device **12** according to one embodiment of the present invention. Referring to FIG. **8**, the optical touch device **12** comprises a processor **81** coupled with an image sensor **82** configured to detect activity of an object on or over a keyboard, a touch pad or an operation point. The image sensor **82** can generate a plurality of pictures, at least one of the plurality of pictures comprising an object image. The processor **81** is configured to execute the processes required by the embodiments of the present invention. The processor **81** can analyze the coordinate data of the object, the displacement vectors of the object, or gestures using the images. In some embodiments, when a position for performing a specific function is arranged for the optical touch device **12** and the processor **81** determines that the object is on the position, the processor **81** performs that specific function. In some embodiments, the processor **81** can establish an input region according to the configuration from a user. In some embodiments, the processor **81** can perform a mapping between an input region and a virtual keyboard. In some embodiments, the processor **81** can determine a pressed key and the key code thereof according to coordinate data of the object. In some embodiments, the processor **81** can further translate a key code into an ASCII equivalent. In some embodiments, the processor **81** can change, according to the configuration from a user, the size of an input region, segment an input region, merge input regions or change the relative positions of two input regions. In some embodiments, the processor **81** is configured to allow a user

to perform different gestures in two input regions according to the configuration from the user. In some embodiments, the processor **81** is configured to allow at least one gesture to be performed in multiple or all input regions according to a user's configuration. In some embodiments, the processor **81** is configured to determine the input region where the object is located according to the coordinate data of the object. In some embodiments, the processor **81** is configured to receive an instruction from a user to allow switching between different functions of an input region. For example, a character input function is switched to a gesture input function similar to the function used in a touch pad.

The optical touch device **12** may comprise a volatile memory **83** configured to store the programs and data required for the operations of the optical touch device **12**. The optical touch device **12** may comprise a non-volatile memory **84**, which is configured to permanently store the operating system of the optical touch device **12**, required programs, user's configurations, and data. The optical touch device **12** may comprise a peripheral **85**, which can be configured to communicate with an external device. The peripheral **85** may comprise a wired device or wireless device. The peripheral device may comprise a USB (Universal Serial Bus) port, PS/2 (Personal System/2) port or other connection ports.

A portion of optical touch devices of the present invention are disclosed below and the present invention is not limited to the disclosed optical touch devices.

FIG. **9** schematically depicts an optical touch device **12***a* according to one embodiment of the present invention. The optical touch device **12***a* comprises two image sensors **121** and a processor **122**. The image sensors **121** can detect the activity of an object **92** in a detectable area **91**. The processor **122** is coupled with the image sensors **121** for analyzing the pictures generated by the image sensors **121**, thereby acquiring the coordinate data of the object **92**, the displacement vector data of the object **92**, or the gestures of the object **92**. The method for calculating the coordinate data of an object refers to U.S. patent application Ser. No. 13/302,481, the disclosure of which is incorporated by reference herein.

FIG. **10** schematically depicts an optical touch device **12***b* according to another embodiment of the present invention. The optical touch device **12***b* comprises an image sensor **121**, a processor **122**, and a mirror element **102**. The mirror element **102** comprises a mirror surface **1021**, which can generate a reflection **106** of an object **92**. The image sensor **121** can detect the object **92** in a detectable area **91** and the reflection **106** of the object **92**. The processor **122** is coupled with the image sensor **121** for analyzing pictures from the image sensor **121**. The processor **122** can use the images of the object **92** and the images of the reflection **106** to determine the coordinate data of the object **92**, the object displacement vector data, or gestures. The method for determining coordinate data or gestures refers to U.S. Pat. No. 7,689,381 B2, U.S. patent application Ser. No. 13/302,481, and U.S. patent application Ser. No. 13/606,942, the disclosures of which are incorporated by reference herein. In addition, the optical touch device **12***b* can further comprise at least one light-projecting element **103** or **104**, which is configured to provide light for the detectable area **91**, wherein the light-projecting element **103** or **104** can be a light source or a light guide.

FIG. **11** schematically depicts an optical touch device **12***c* according to another embodiment of the present invention. The optical touch device **12***c* comprises two image sensors **121**, a processor **122**, a plurality of retro-reflectors **115**, and two light sources **116**. The two image sensors **121** can detect the activity of an object **92** in a detectable area **91**. The light sources **116** provide light for the detectable area **91**. The retro-reflectors **115** are disposed at the periphery of the detectable area **91** to reflect light from the light sources **116**. The processor **122** is coupled with the image sensors **121** to analyze pictures from the image sensor **121** to determine the coordinate data of the object **92**, the object displacement vector data, or gestures. In some embodiments, the light source **116** comprises a light-emitting diode.

FIG. **12** schematically depicts an optical touch device **12***d* according to another embodiment of the present invention. The optical touch device **12***d* comprises two image sensors **121**, a processor **122**, and a light guide element **125**. The two image sensors can detect the activity of an object **92** in a detectable area **91**. The processor **122** is coupled with the image sensors **121** and can analyze pictures from the image sensor **121** to determine the coordinate data of the object **92**, the object displacement vector data, or gestures. The light guide element **125** extends at least a portion of the periphery of the detectable area for guiding light and projecting light to the detectable area **91**

FIGS. **13** and **14** are views showing optical touch devices **12***e* and **12***f*, respectively, according to another embodiment of the present invention. The optical touch device **12***e* or **12***f* comprises three or more image sensors **121**, which are disposed at corresponding corners of a detectable area **91**. The image sensor **121** is coupled with a processor **122**, which can analyze pictures from the image sensors **121** to determine the coordinate data of the object **92**, the object displacement vector data, or gestures.

FIG. **15** is a flow diagram showing the steps of a method for an optical touch device according to one embodiment of the present invention. Referring to FIG. **15**, in Step **S151**, an optical touch device is initiated after it is activated. In Steps **S152** and **S153**, the optical touch device starts to perform a scanning operation. When no object is found in a detectable area, the optical touch device continues to scan. In Step **S154**, when the optical touch device detects an object, the optical touch device determines the position of the object. In Step **S155**, the optical touch device determines whether the object is in a keyboard area. If so, the method proceeds to Step **S156**; if not, the method proceeds to Step **S157**. In Step **S156**, the optical touch device determines which key the object has touched and generates a corresponding key code. In Step **S157**, the optical touch device determines whether the object is on an operation point. If so, the method proceeds to Step **S158**; if not, the method proceeds to Step **S159**. In Step **S158**, the optical touch device detects the activity of the object on the operation point and generates a corresponding event. In Step **S159**, the optical touch device determines whether the object is on a touch pad region. If so, the method proceeds to Step **S160**; if not, the method proceeds to Step **S161**. In Step **S160**, the optical touch device detects the activity of the object on the touch pad region and generates a corresponding event. In Step **S161**, if the object is not in the keyboard area, on the operation point and on the touch pad region, the optical touch device determines that the position information of the object is invalid. Under such a circumstance, the optical touch device may report a message or neglect detecting results, and the method proceeds back to Step **S152**.

In some embodiments, an optical touch device is configured to have the functions of a plurality of input devices. The optical touch device allows users to perform several gestures on a region, which leads to an increase in convenience. In addition, if electronic devices adopt the optical touch device, the design of their hardware and software can be simplified

and their cost can be reduced. The input region of the optical touch device can be flexibly defined and is not limited by an existent hardware configuration. The output data can also be flexibly defined. The format of data can follow existing standards or be defined by users.

The data structures and code described in this detailed description are typically stored on a non-transitory computer-readable storage medium, which may be any device or medium that can store code and/or data for use by a computer system. The non-transitory computer-readable storage medium includes, but is not limited to, volatile memory, non-volatile memory, magnetic and optical storage devices such as disk drives, magnetic tape, CDs (compact discs), DVDs (digital versatile discs or digital video discs), or other media capable of storing code and/or data now known or later developed.

The methods and processes described in the detailed description section can be embodied as code and/or data, which can be stored in a non-transitory computer-readable storage medium as described above. When a computer system reads and executes the code and/or data stored on the non-transitory computer-readable storage medium, the computer system performs the methods and processes embodied as data structures and code stored within the non-transitory computer-readable storage medium. Furthermore, the methods and processes described below can be included in hardware modules. For example, the hardware modules can include, but are not limited to, application-specific integrated circuit (ASIC) chips, field-programmable gate arrays (FPGAs), and other programmable-logic devices now known or later developed. When the hardware modules are activated, the hardware modules perform the methods and processes included within the hardware modules.

It will be apparent to those skilled in the art that various modifications can be made to the disclosed embodiments. It is intended that the specification and examples be considered as exemplary only, with the true scope of the disclosure being indicated by the following claims and their equivalents.

What is claimed is:

1. An electronic system comprising:

a device comprising a unitary screen integrated into the device, the screen having defined thereon a plurality of regions; and

an optical touch device configured to detect activity of an object touching the screen, the optical touch device being configured to generate first data when the object performs a gesture touching and moving along a surface of a first region of the screen and to generate second data when the object performs a gesture touching and moving along a surface of at least a second region of the screen, wherein

the first data and the second data are of different data types,

the first region is separate from the second region,

the optical touch device is configured to generate a first gesture event in response to the gesture being performed touching and moving along the surface of the first region that is different from a second gesture event generated in response to the same gesture being performed touching and moving along the surface of the second region, and

the optical touch device is further configured to generate at least one of a track point and a pointing stick event in response to the object touching a predetermined operation m point defined in one of the first and second regions, the at least one of a track point and a pointing stick event being determined based on a posture of the object while touching the predetermined operation point.

2. The electronic system of claim **1**, wherein the screen displays a virtual keyboard on the first region of the screen, and the first data comprises a key code.

3. The electronic system of claim **2**, wherein the optical touch device is configured to stop generating data when a plurality of objects are on the first area.

4. The electronic system of claim **1**, wherein the first data comprises a displacement vector.

5. The electronic system of claim **1**, wherein the second data comprises coordinate data.

6. The electronic system of claim **1**, wherein the optical touch device is configured to generate the first data when the object moves away from the first region of the screen.

7. The electronic system of claim **1**, wherein the optical touch device is configured to provide different types of input mechanisms that are receivable via the second region.

8. The electronic system of claim **7**, wherein the screen displays a virtual keyboard on the first region, and the second region is configured for gesture input.

9. The electronic system of claim **7**, wherein the first and second regions are respectively configured for different types of gesture input.

10. The electronic system of claim **7**, wherein the first and second regions are user-configurable.

11. The electronic system of claim **1**, wherein when a gesture is performed on the first region and the second region, the optical touch device is configured to execute a function related to one of the first and second regions, on which the gesture lasts longer or from which the gesture starts.

12. The electronic system of claim **1**, wherein the first region comprises an operation point, wherein the optical touch device is configured to stop generating the first data when the object is on the operation point.

13. The electronic system of claim **1**, wherein the screen displays an operation point, wherein the optical touch device is configured to generate a gesture event when the object tilts on the operation point.

14. The electronic system of claim **1**, wherein the screen displays an operation point having a shortcut function.

15. The electronic system of claim **1**, wherein the optical touch device is configured to allow the first region to correspond to different switchable input functions.

16. An electronic system comprising:

a device comprising a unitary screen integrated into the device, the screen having defined thereon a plurality of regions; and

an optical touch device configured to detect activity of an object touching the screen, the optical touch device being configured to generate first data when the object performs a gesture touching and moving along a surface of a first region of the screen and to generate second data when the object performs a gesture touching and moving along a surface of at least a second region of the screen, wherein

the first data and the second data are of different data types,

the first region is separate from the second region, and

the optical touch device is further configured to generate at least one of a track point and a pointing stick event in response to the object touching a predetermined operation point defined in one of the first and second regions, the at least one of a track point and a pointing

stick event being determined based on a posture of the object while touching the predetermined operation point.

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